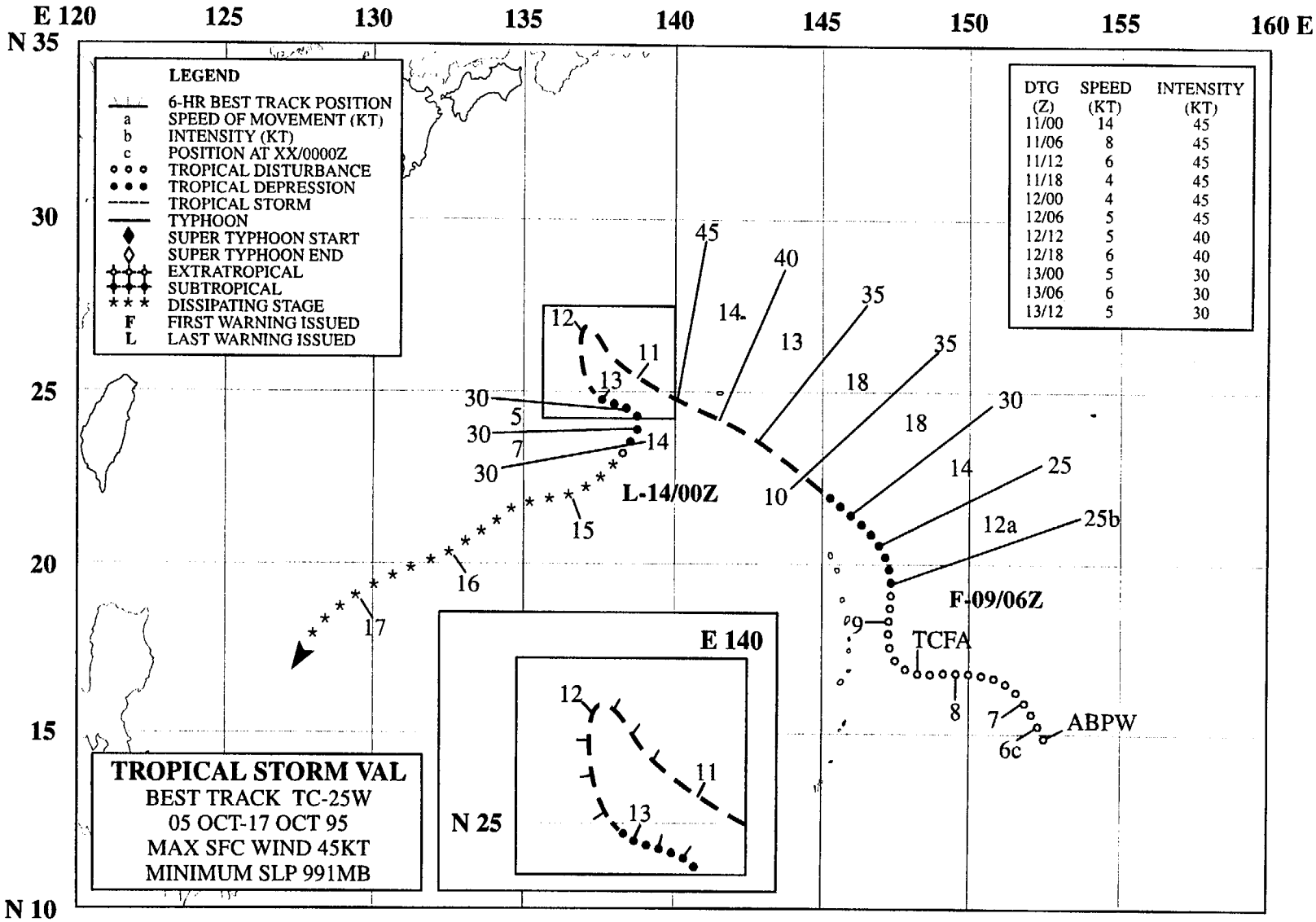
E 120
125
130
135
140
145
150
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160 E
N 35
30
25
20
15
N 10
LEGEND
6-HR BEST TRACK POSITION
a SPEED OF MOVEMENT (KT)
b INTENSITY (KT)
c POSITION AT XX/0000Z
TROPICAL DISTURBANCE
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON
SUPER TYPHOON START
SUPER TYPHOON END
EXTRATROPICAL
SUBTROPICAL
DISSIPATING STAGE
F FIRST WARNING ISSUED
L LAST WARNING ISSUED
DTG (Z) SPEED (KT) INTENSITY (KT)
11/00 14 45
11/06 8 45
11/12 6 45
11/18 4 45
12/00 4 45
12/06 5 45
12/12 5 40
12/18 6 40
13/00 5 30
13/06 6 30
13/12 5 30
L-14/00Z
F-09/06Z
TCFA
ABPW
E 140
N 25
TROPICAL STORM VAL
BEST TRACK TC-25W
05 OCT-17 OCT 95
MAX SFC WIND 45KT
MINIMUM SLP 991MB

TROPICAL STORM VAL (25W)

I. HIGHLIGHTS

Tropical Storm Val interacted with a monsoon gyre. This interaction coupled with the structural evolution of Val contributed to large track forecast errors.

II. TRACK AND INTENSITY

During the first week of October, an extensive area of deep convection and its associated cirrus debris stretched east-west from Southeast Asia to the Marshall Islands. This zone of maximum cloudiness, associated with a weak monsoon trough and a well-developed TUTT to its north, eventually produced two tropical disturbances that became named tropical cyclones: Typhoon Ted (24W), and Tropical Storm Val.

When Ted (24W) began to consolidate east of the Philippines, the zone of maximum cloudiness had moved northward, and stretched from the Philippines eastward past Guam. This band of deep convection was first mentioned on the 051800Z October Significant Tropical Weather Advisory. Val developed within this area of deep convection, but not until the large-scale low-level wind flow and the large scale pattern of deep convection became organized as a monsoon gyre.

At 080800Z October, a Tropical Cyclone Formation Alert (TCFA) was issued on this tropical disturbance. Remarks on this TCFA included:

". . . Satellite imagery and synoptic data indicate that a tropical disturbance located approximately 200 nm [370 km] northeast of Guam is becoming better organized. The area is located beneath an upper level anticyclone and outflow is being enhanced by the presence of an upper-level low (TUTT cell) to the northwest. . ."

During the daylight hours of 09 October, the tropical disturbance that became Val consolidated into a well-organized area of deep convection to the northeast of Guam. It was embedded in a larger band of deep convection that wrapped around the periphery of a monsoon gyre whose broad center was located north-northwest of Guam and about 450 nm (850 km) west-northwest of the pre-Val tropical disturbance (Figure 3-25-1). Turning northward, as it interacted with the circulation of the monsoon gyre, the tropical disturbance intensified and the JTWC issued the first warning valid at 090600Z October on Tropical Depression 25W.

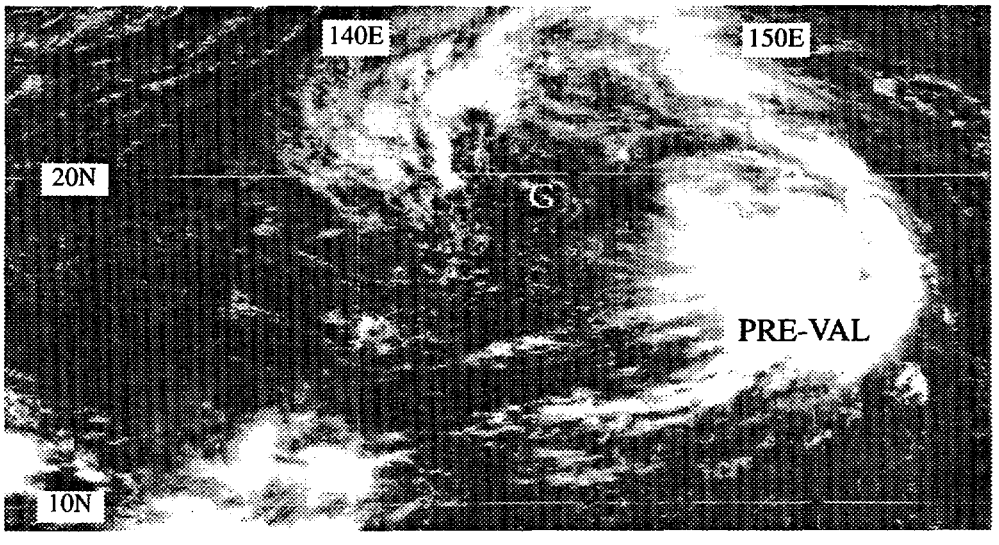

Figure 3-25-1 The tropical disturbance that became Val is located in the eastern side of the circulation of a monsoon gyre whose center is labeled "G" (090031Z October visible GMS imagery).

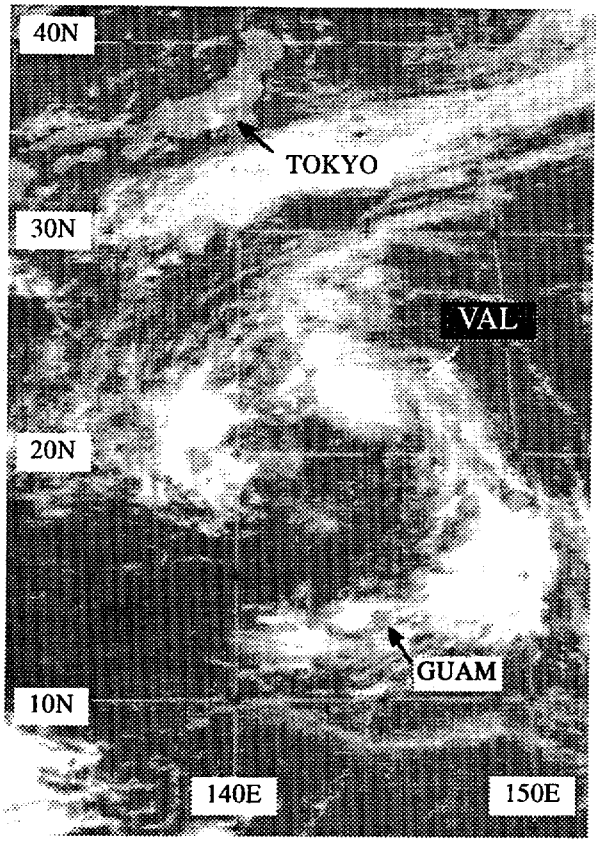

Figure 3-25-2 The CDO of Val is located to the northeast of the center of the monsoon gyre (100131Z October visible GMS imagery).

At 100000Z October, Tropical Depression 25W was upgraded to a tropical storm based upon persistent central deep convection (Figure 3-25-2). Remarks on this warning included:

". . . Tropical Depression 25W has been upgraded to Tropical Storm Val . . . Latest Satellite imagery indicates that Val is orbiting around a larger monsoon gyre. Our forecast is for these two systems to merge in the next 24 to 36 hours then move off to the west-northwest. . . ."

By 11 October, Val had orbited from the eastern side of the gyre to its northern side (Figure 3-25-3). While located north of the center of the monsoon gyre, Val stalled and began to undergo vertical shearing from the west. On the morning of 12 October, visible satellite imagery (Figure 3-25-4) indicated that the low-level circulation center of Val was sheared to the west of the deep convection. Earlier during the previous night, the low-level circulation center was thought to have moved to the northeast under the deep convection, leading to a nearly 120 nm (225 km) relocation in the morning (a perfect example of the phenomenon known as the "sunrise surprise"). These diagnostic problems led to some very large forecast track errors (see discussion).

Eventually, all of the deep convection was sheared away, and Val merged with the monsoon gyre; the merged vortex drifted to the west-southwest and slowly dissipated. The final warning valid at 140000Z was issued when all deep convection was lost and only a low-level circulation center remained.

III. DISCUSSION

a. *Tropical cyclone interaction with a monsoon gyre*

A monsoon gyre is one of several patterns of the summer monsoon flow of the western North Pacific. As a monsoon gyre, the low-level circulation of the western North Pacific becomes organized as a large cyclonic vortex associated with a nearly circular 2500-km-wide depression in the contours of the sea-level pressure (e.g., see Figure 3-25-3). Typically, a cyclonically curved band of deep convection rims the southern through eastern periphery of this large vortex — in the case of the October 1995 monsoon gyre, the deep convection wrapped all the way around to the northwestern side of the gyre (see Figure 3-25-2). Also typical of a monsoon gyre is the formation of small or very small tropical cyclones in the peripheral cloud band of the gyre. Historically, most tropical cyclones that interact with a monsoon gyre undergo one of three possible fates (Figure 3-25-5): (1) the tropical cyclone orbits the gyre within the northeast quadrant of the gyre, and then escapes the influence of the gyre and recurves, (2) the tropical cyclone merges with the gyre and the two become one large circulation, and (3) the tropical cyclone, upon reaching the northern side of the gyre continues to move westward, or west-southwestward, in tandem with the gyre or between the gyre and an anticyclone to its northwest. In Val's case, it appeared that upon reaching the north side of the monsoon gyre, that it came very close to recurving. Instead, it

stalled for two days, its convection was sheared away, and the remnant vortex merged with the gyre and then moved to the west-southwest and dissipated near the Philippines.

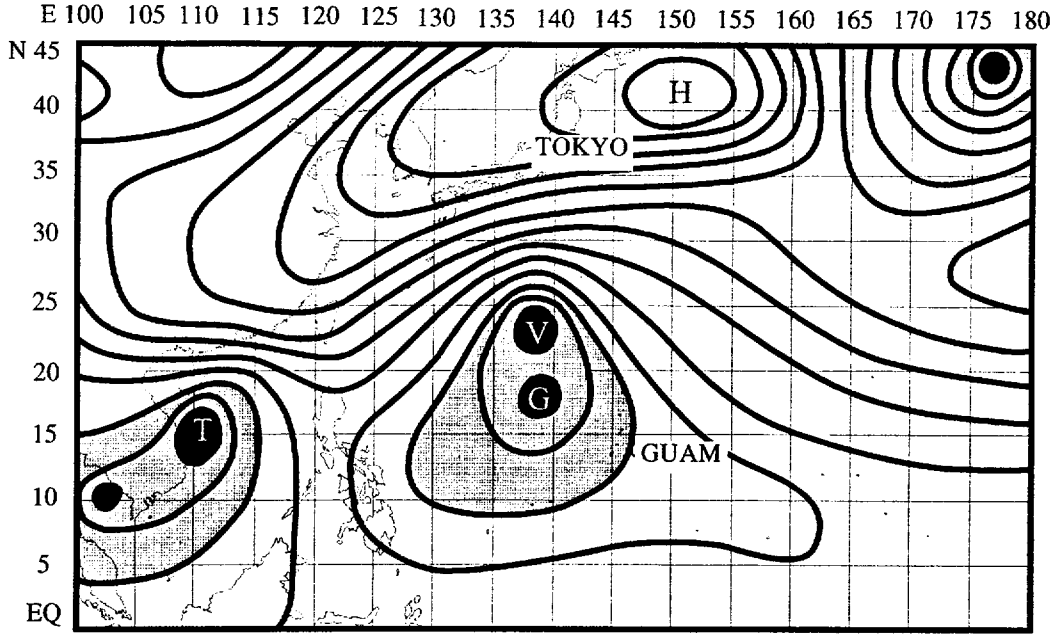

Figure 3-25-3 Contours of sea-level pressure (SLP) (at 2 mb intervals) at 110000Z October showing Val (V) located to the north of the center of the monsoon gyre (G). Another tropical cyclone — Ted (T) — is located in the South China Sea. Shaded region shows area where SLP is 1010 mb or lower; regions of SLP of 1006 mb or lower are black.

b. *Large track errors*

Val had large 48- and 72-hour track forecast errors (Figure 3-25-6). The four forecasts made between 110600Z and 120000Z each exceeded 1000 nm (1850 km) at 72 hours — the largest of these errors was 1386 nm (2550 km). The four forecasts made between 100600Z and 110000Z each exceeded 600 nm (1125 km) at 72 hours as a result of assuming that Val would continue to move steadily westward after rounding the northern side of the monsoon gyre. The largest of all the track forecast errors — those that occurred between 110600Z and 120000Z — resulted from an incorrect anticipation that Val would recurve.

Diagnostic errors during the night hours of 11 October contributed to the erroneous forecasts for Val to recurve. During the night hours of 11 October, the deep convection associated with the low-level circulation center of Val appeared to be moving northward. The satellite fix positions incorrectly followed the convection northward, while in reality, the deep convection was being sheared away from the low-level circulation center. By the first light of the morning of 12 October, the extent of the diagnostic errors became known. Based upon visible satellite imagery (Figure 3-25-4), the low-level circulation center of Val was repositioned approximately 120 nm to the west-southwest of the night infrared position estimate. Also contributing to the nighttime choice of recurvature were some dynamic model indications that Val would recurve.

In retrospect, it is possible that an SSM/I image of Val at 1110005Z October (Figure 3-25-7) could have been used to diagnose the sheared condition of Val, and that this information could have been used by the JTWC to reconsider its forecasts of recurvature before the morning visible satellite imagery revealed the diagnostic error.

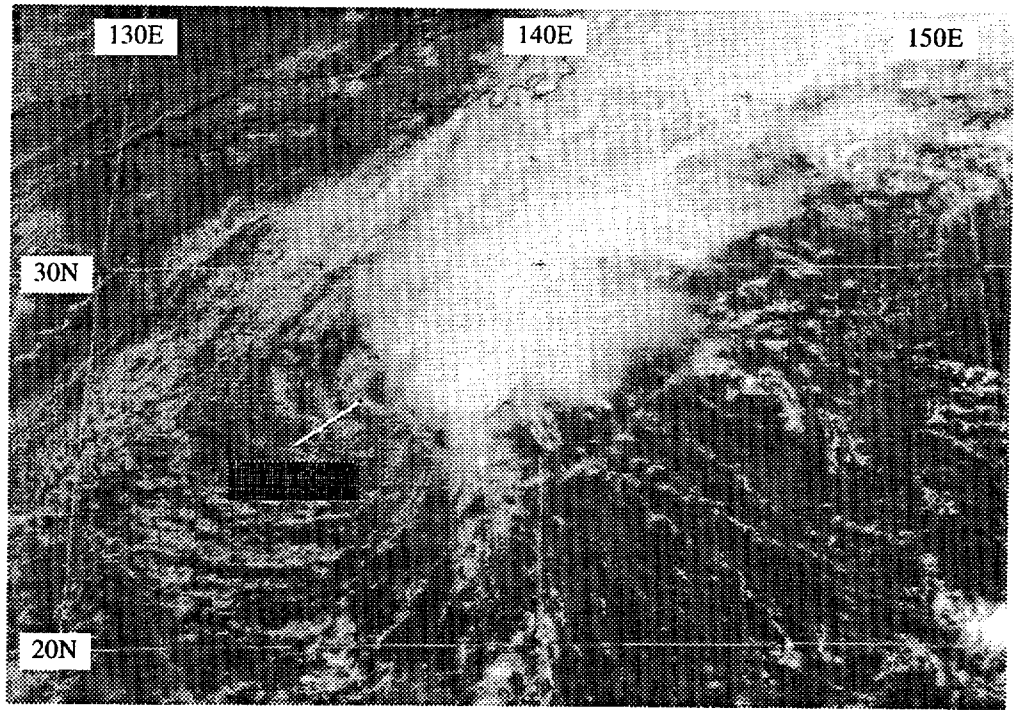

Figure 3-25-4 Val's low-level circulation center (marked LLCC) is located to the west of the deep convection (112224Z October visible GMS imagery).

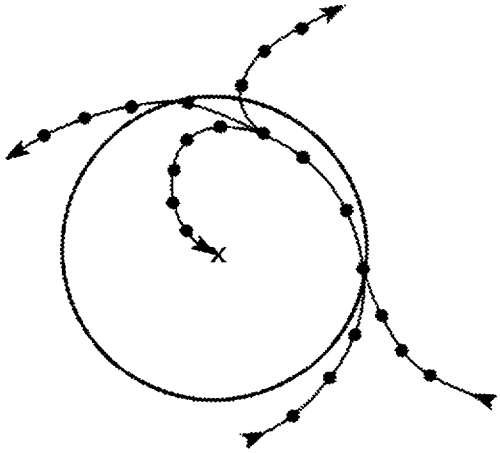

Figure 3-25-5 A schematic illustration of the typical interactions between a tropical cyclone and a monsoon gyre. The circle represents the outermost closed isobar of the monsoon gyre. Possible cyclone tracks are shown with respect to the center of the monsoon gyre.

IV. IMPACT

No reports of damage or injuries were received at the JTWC.

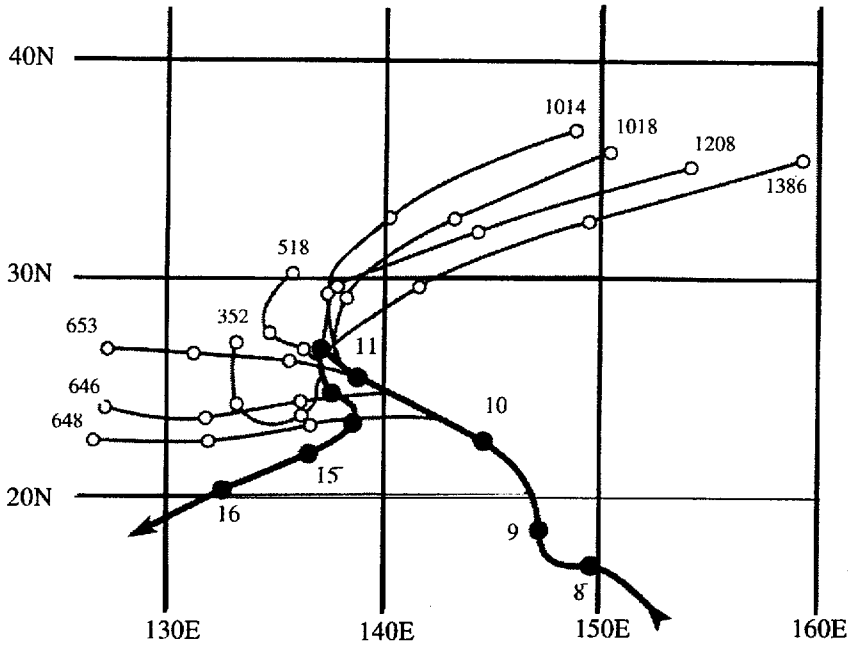

Figure 3-25-6 A schematic illustration of some selected track forecasts made by the JTWC for Val. The track of Val is indicated by the thick black line with black dots indicating the 0000Z positions of the indicated day. Small open circles connected by thin lines are selected JTWC track forecasts. Each track forecast has three open circles indicating the 24-, 48- and 72-hour forecast positions. The small numbers at the 72-hour forecast positions indicate the error associated with that forecast position (units are nm).

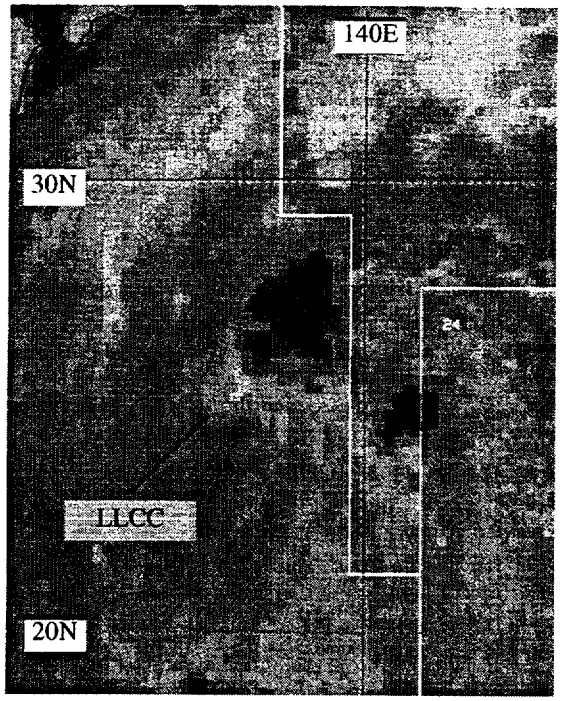

Figure 3-25-7 An 85 GHz (horizontally polarized) microwave image of Val showing that the deep convection is sheared to the northeast of the low-level circulation center (111005Z October SSM/I DMSP imagery).